US-PAT-NO: 4685448

DOCUMENT-IDENTIFIER: US 4685448 A

****See image for Certificate of Correction****

TITLE: Vocal tactile feedback method and associated apparatus

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Brief Summary Text - BSTX (10):

It has been known in treating certain types of stuttering to measure muscle activity in the lip, chin, larynx and frontalis muscle region and provide an audio signal of a frequency proportional to the level of muscle activity. See Guitar, Journal of Speech and Hearing Research, Vol. 18, No. 4, pp. 672-685, (Dec. 1975).

Brief Summary Text - BSTX (11):

It has also been known to record surface electromyograms from the larynx, chin, lip and trapezious. The feedback is in the form of a tone generated in response to muscle activity. See Hardyck et al., Feedback of Speech Muscle Activity During Silent Reading: Rapid Extinction, Institute of Human Learning, Univ. of Cal., Berkeley, (Aug. 1967) and Hardyck et al. Science, Vol. 154, pp. 1467-1468, Dec. 16, 1966.

Brief Summary Text - BSTX (14):

U.S. Pat. No. 3,453,749 discloses an apparatus and method for use by a speech therapist or instructor in teaching persons having speech abnormalities. That invention involves the electronic amplification of the instructor's vocal utterance and the direct application of amplified vibrations through a throat transducer to the larynx region of the throat. While that device and method are helpful in the treatment of certain types of speech abnormalities, they do not provide a satisfactory solution to the problem of stuttering.

Brief Summary Text - BSTX (21):

It is another object of the invention to provide heightened user awareness by accentuating normal vibratory sensations produced by the larynx by applying delayed and amplified speech signals to the laryngeal region by an external electro-mechanical transducer.

Detailed Description Text - DETX (20):

As is shown in FIG. 8, a signal from microphone 130 which may be a low impedance dynamic type, passes by lead 132 to gain 134 which may be an amplifier having a gain of about 16. Depending upon the position of filter select switch 160 the signal emerging from gain 134 on lead 150 will pass through one of the low pass filters 140, 142, 144. If desired, a single low pass filter could be employed in lieu of filters 140, 142, 144 with switch 160 being eliminated. These filters may, for example, respectively, have cutoff frequencies of 2 KHz, 3 KHz and 4 KHz. These filters limit the high frequencies going to the delay circuit. The signal then passes to equalizer A 162 which may be a 12 band equalizer and by leads 166, 174 to variable audi delay circuit 170 which has delay adjustment 172. The equalizer 162 may be employed to emphasize or de-emphasize selected frequency bands of the user's voice. It also may be employed to reduce acoustic feedback between the microphone and vibration transducer. Depending upon the position of delay select switch 180 the signal on lead 166 entering delay circuit on lead 174 will enter delay circuit 170 and pass through switch 180 to spectrum analyzer 184 or the feedback signal from transducer sensor 207 may be lead 208 enter spectrum analyzer 184. The spectrum analyzer 184 serves to measure spectral content of the electrical signal applied to the transducer. Alternately, the analyzer can display the amplitude spectrum of the tactile vibrations applied to the patient's throat by means of an amplitude sensor such as a strain gauge sensor mounted on the transducer, for example. In this mode of operation, a "pink noise" generator can be advantageously connected at the input system in lieu of the microphone. Reference herein to use of a microphone shall be deemed to embrace such a practice. The analyzer will then yield a direct measure of the amplitude response of the system with uniform energy excitation over the selected frequency band.

Detailed Description Text - DETX (22):

The form shown in FIG. 8 is best suited to use in vocal feedback apparatus for clinical application. For compact, battery powered units, such as that shown in FIGS. 1 and 2, there will not normally be provided with an equalizer, a spectrum analyzer or adjustable low pass filters as this minimizes size, weight and power requirements.

Detailed Description Text - DETX (24):

Referring to FIG. 10, details of a form of delay circuit will be considered employing certain new reference numbers for convenience of reference. The variable time delay circuit shown enables an analog time delay which is preferably adjustable in the range from about 0.03-0.05 sec. A signal from equalizer 152 is introduced into analog delay line 220 by leads 166, 218. The clock frequency is provided by a multivibrator 224 with an adjustable frequency established by adjustment means 226. Lead 228 is at the desired predetermined voltage. Lead 222 connects clock input of analog delay line 220 with

multivibrator 224. A standard RD 5108 delay line may be used. If desired, additional stages can be added to improve the accuracy of the delayed output at high frequencies. Thus, the sampling rate can be doubled by adding a second series delay line improving the resolution of the delayed output, particularly at maximum delay. The "glitch" filter shown in the block diagram serves to smooth the output of the delayed signal. Shorter delays are possible by increasing the clock frequency (zero delay can be obtained by simply bypassing the delay circuit). Lead 240 carries the signal from analog delay line 220 to low pass filter 242 having feedback components 244, 246. Output on lead 250 depending on position of switch 181 may be delivered to equalizer 162 on lead 252.

US-PAT-NO: 4343969

DOCUMENT-IDENTIFIER: US 4343969 A

TITLE: Apparatus and method for articulatory speech recognition

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Detailed Description Text - DETX (12):

Further enabling precise recognition of a particular articulatory filter function but not being necessarily deemed to limit the spirit and scope of the present invention of a means of recognition and classification of articulation, a preemphasis circuit 26 and automatic level control circuitry 28 are used between the speech waveform input 30 and the input to inverse filter bank 12. As previously stated, the preemphasis circuit amplifies higher frequencies with respect to lower frequencies and tends on the average to equalize amplitudes of the various frequency components of the raw speech wave. An overall balance of the average speech spectrum is obtained which facilitates distinguishing the various forms of articulation by transforming the glottal impulse into a narrow pulse representing a delta function, whereby the input waveform transfer function tends to appear as the result of the passive vocal tract without regard to the source. Overlap effects, however, due to recurrent impulse excitation of the passive vocal tract are still present.

Detailed Description Text - DETX (36):

The basic measurement for establishing recognition criteria of a given sound as spoken by a given person is the vocal tract impulse response, and subsequently, by Fourier transformation, the vocal tract transfer function. The vocal tract impulse response may be ascertained from a given person by use of an "artificial larynx" or by a transducer inserted into the vocal tract for the introduction of source impulses into the vocal tract. The resulting output sound may be recorded via microphone a distance from the lips. An important requirement of these methods is that the impulse rate be made low enough that there is no overlap in the filter responses (where the vocal tract is treated as a filter). The impulse response of a filter is by definition its output in response to a single (ideal) impulse. If overlap occurs due to multiple source impulses, the output is an inaccurate representation of the impulse response. It may be noted that the voiced sounds of very low pitched speakers appear as a series of impulse responses with very little overlap, therefore these may be used directly in obtaining the vocal tract transfer function and subsequently the inverse filter bank.

Detailed Description Text - DETX (65):

The operation of preemphasis or "spectral flattening" approximates a flat long-term average spectrum to the inputs of the bank of vocal-tract inverse filters. A test for normalization of the filter bank may be understood as a test for equalization of loss (at zero in the ideal case) over the entire bank. Equalization of loss can be tested by the application of a white noise voltage to the filter bank after preemphasis and the measurement of RMS voltage at each filter output. When all RMS outputs are equal, the filter bank is properly normalized, and will respond to input speech sounds without predisposition.

US-PAT-NO:	6343269
DOCUMENT-IDENTIFIER:	US 6343269 B1
TITLE:	Speech detection apparatus in which standard pattern is adopted in accordance with speech mode

Brief Summary Text - BSTX (7):

On the other hand, studies of acquiring speech information from information other than sound information have been made conventionally. The vocal organs directly relating to vocalization of a human are the lungs 901 as an air flow mechanism, the larynx 902 as a vocalization mechanism, the oral cavity 903 and the nasal cavity 904 that assume the mouth/nasal cavity function, and the lips 905 that assume the articulation function, though the classification method varies from one technical book to another. FIG. 9 shows the arrangement of those organs (the lungs 901 are not shown). Studies of acquiring speech information from visual information of the lips 905 among these vocal organs have been made to provide techniques for people handicapped in hearing. It was pointed out that the speech recognition accuracy can be improved by adding visual information of movements of the lips 905 of a speaker to a speech recognition technique (C. Bregler, H. Hild, S. Manke, and A. Waible, "Improving Connected Letter Recognition by Lipreading", Proc. IEEE ICASSP, pp. 557-560, 1993).

Detailed Description Text - DETX (26):

This method was applied to the specular reflection light spot method in the following manner. Light spot data obtained from speech of each syllable is represented by a set (vector) of discrete values of respective time frames. Therefore, Equation (2) was employed in the experiment. To compare two data by using Equation (2), it is necessary to equalize the phases and the lengths of speech data. Reference time 151 for the phase equalization was set at the center of the width taken at the 1/3 value from the bottom of the fall portion of the Y-coordinate component of speech data (see FIG. 15). The data length of a phoneme (or syllable) was so unified as to be a 31-dimensional vector consisting of first-half 16 frames and second-half 15 frames including the reference time. The degree of similarity was determined between input data and templates of 48 phonemes (or syllables) in total including phonemes of the four speech modes and closest phonemes (or syllables) of standard patterns were employed as recognition results of the input data.

Detailed Description Text - DETX (29):

To summarize the above, it has been confirmed that in the voiceless speech mode and the loud voice speech mode the speech detection accuracy can be improved by equalizing the speech modes of input data and a standard pattern. In particular, this embodiment has shown that when the input data is of the voiceless speech mode, by providing the means for switching the speech mode of a standard pattern (to the voiceless speech mode), the recognition rate of phonemes (or syllables) can be made two times that of the case where the speech mode of a standard pattern is fixed to the ordinary speech mode (see FIG. 21). Also, in the cases of the small voice speech mode and the ordinary speech mode, although selecting a standard pattern of the same speech mode as that of input data and using the selected standard pattern for the recognition did not produce the best result, it is meaningful in that it is better than using a standard pattern of a much different speech mode. It goes without saying that making the speech modes of input data and a standard pattern the loud speech mode is included in the invention though its value in terms of industrial use is low because of annoyance to nearby people. It is also included in the invention to equalize the speech modes of input data and a standard pattern in accordance with the speech mode of a person whose articulator is disordered.

US-PAT-NO: 4039756

DOCUMENT-IDENTIFIER: US 4039756 A

TITLE: Artificial larynx with semi-automatic inflection control

Abstract Text - ABTX (1):

An artificial larynx helps people speak with less monotonous voice by providing an automatic pitch changer for voice inflection. The predetermined basic vocal pitch frequency circuit is modulated by a frequency control signal whose value changes at a predetermined rate established by an RC circuit, and includes switches manually-operable to select upward or downward pitch change inflections.

TITLE - TI (1):

Artificial larynx with semi-automatic inflection control

Brief Summary Text - BSTX (3):

This invention relates to an artificial larynx and more particularly to an electrically-powered artificial larynx having pitch change capability.

Brief Summary Text - BSTX (5):

Persons who have been deprived of the use of their vocal chords or larynx through paralysis or surgery for example, frequently employ a mechanical or electro-mechanical speech aid commonly known as an artificial larynx. The basic operating principal of such a device is to generate a tone having a fundamental frequency in the speech range of the average human voice and to introduce the tone into one of the resonant speech cavities of the user, such as the mouth or pharnyx. To speak, the user modulates the artificially-generated tone by varying the shape of the resonant speech cavities comprising the pharnyx, mouth and nose and by making the usual constrictions of the tongue, teeth and lips so as to articulate the modulated tone as human speech.

Brief Summary Text - BSTX (6):

One well-known type of artificial larynx employs a tracheal tube with one end inserted into a surgically made aperture in the users throat which terminates at the users trachea. The force of accelation through the tube is applied to a reed which vibrates to produce the

required tone. The sound from the vibrating reed is introduced into the mouth or nasal cavity by means of a second tube.

Brief Summary Text - BSTX (8):

Still another type of artificial larynx employs an electro-mechanical vibrator adapted to be secured to or held against the outside of the users throat so as to induce a tone into the region of the pharnyx. The generated sound is transmitted through the tissues of the throat and into the mouth where it is articulated into words and phrases.

Brief Summary Text - BSTX (13):

These drawbacks of the prior art are the major reason why only about 15% of voiceless people utilize an artificial larynx. It would be extremely advantageous to humanize the sound emitted by a person using an artificial larynx by improving the tonal quality and reducing the requirements for manual dexterity and coordination so as to produce a less mechanical sounding and more human-like speech.

Brief Summary Text - BSTX (14):

The present invention avoids all of the problems and disadvantages of the prior art by providing an artificial larynx which produces a more human-like tonal quality and which provides a pitch change circuit wherein the direction of pitch may be manually selected but the total amount of change and the rate of change is pre-established so as to eliminate the users need for manual dexterity and insure the generation of a less monotonous, more human-like quality in the resulting speech.

Brief Summary Text - BSTX (16):

This invention provides an artificial larynx having means for generating electrical pulses at a predetermined frequency in the average fundamental frequency range of the human voice. A transducer means is provided for vibrating at the predetermined basic frequency to generate sound waves which can be articulated in a person's speech cavities for speech purposes. An electrical driver responsive to the generated electrical pulses is used to drive the transducer means. A pitch change circuit is provided which includes RC circuit means for generating a frequency control signal whose value varies at a predetermined rate established by the RC time constant of the circuit. The frequency control signal is supplied to the pulse-generating means so that the rate of change of the value of the frequency control signal determines the rate at which the frequency of generation of the electrical pulses changes. Manually-operable switching means are coupled to the RC circuit means for enabling the

person to selectively increase the value of the control signal so as to increase the frequency of generation of the electrical pulses at the established predetermined rate or for enabling a person to selectively decrease the value of the control signal so as to decrease the frequency of generation of the electrical pulses at the established predetermined rate thereby permitting the person to select a direction of inflextion in the pitch of the sounds articulated in his speech cavities without his having to worry about jerky machine-like variations resulting from less than ideal manual manipulations in the rate.

Brief Summary Text - BSTX (18):

The automatic variation of the rate of change of pitch avoids the manual dexterity problems of selecting and controlling the rate of pitch change inherent in the prior art devices. This avoids the rough, jerky pitch changes which cause the prior art devices to produce a computer-like sound. Accordingly, this invention eliminates a serious prior art limitation and gives the simulated speech a more pleasing and natural quality and an improved clarity. This invention gives the user of an artificial larynx the choice of direction of the pitch change but leaves the actual changing of the pitch and the determination of the rate of change up to the circuitry of the instrument itself. The resulting speech is more natural because the user is able to concentrate more on what he is saying rather than on how to say it and how to manipulate control knobs with his fingers while doing so.

Brief Summary Text - BSTX (19):

The pitch is extremely important because when people speak and wish to emphasize a point they will vary the pitch of their voice in a desired direction. For example, to say "no" with an upward inflection can produce a different meaning than saying "no" with a downward inflection. The few prior art devices capable of varying pitch at all require the manual adjustment or movement of a control knob or member each increment of which changes pitch a particular amount. This gives the speaker the conscience responsibility for manually varying the pitch of his voice which amounts to giving him primary responsibility for what is really of secondary importance in normal speaking. That is, automatic pitch variation more nearly approaches normal speech because it offers the speaker a simple choice, i.e., the choice of direction of the pitch variation. The amount of change, the rate of change, and the final value of the pitch is left up to automatic circuitry. The undesirable requirement for continual manual control of pitch change and rate of change has been eliminated and automatic bi-directional control has been achieved by the artificial larynx of the present invention.

Detailed Description Text - DETX (2):

FIG. 1 is a front perspective view of the exterior of a typical artificial larynx which may embody the circuitry of the present invention;

Detailed Description Text - DETX (3):

FIG. 2 is a perspective view of the exterior of another embodiment of the artificial larynx of the present invention;

Detailed Description Text - DETX (4):

FIG. 3 is an electrical schematic diagram, partially in block form, of the artificial larynx of the present invention including the pitch control circuitry therefore;

Detailed Description Text - DETX (8):

FIG. 1 shows an artificial larynx 10 having a body portion 11 and a forward end portion 12 which houses a vibrating disk 13 which may be placed against a person's throat to produce sound which is supplied from the throat to the mouth where it can be articulated into words. The body portion 11 of the artificial larynx 10 of FIG. 1 includes an on-off switch 14 which extends through an aperture 15 in the body 11 and a two-position control switch 16 which extends through an aperture 17 in the body portion 11 for manually selecting the direction of pitch change as hereinafter described.

Detailed Description Text - DETX (9):

FIG. 2 shows another embodiment of an artificial larynx 18 having a body portion 19 which contains a conventional vibrating element (not shown) which emits sound waves through the tone portion 20 directly into a persons mouth where the sound waves may be articulated into words and phrases. The housing 18 is shown as including a first on-off push button 21 and second and third push button switches 22, 23 which can be used to select the direction of pitch change as hereinafter described. The particular design of the housing 11, or 19 of the artificial larynx of the present invention and the particular structure and operation of the transducer means used to generate the basic sound wave is conventional and any structure compatible with applicant's circuitry may be employed.

Detailed Description Text - DETX (10):

FIG. 3 is an electrical schematic diagram of the artificial larynx 10 or 18 of the present invention. FIG. 3 shows a pulse-generating circuit generally represented by reference numeral 24, an RC network 25 associated with the pulse-generating circuit 24 for establishing the normal frequency at which the electrical output pulses are

generated, a pitch control circuit 26 for automatically controlling the amount and rate of pitch change and for manually selecting the direction thereof, and transducer circuitry 27 which includes a conventional vibratory transducer 28 and the drive circuitry therefore.

Detailed Description Text - DETX (15):

When the switch 48 is closed to turn the artificial larynx of FIG. 3 on, power is supplied from the source 39 to the RC series branch comprising charging resistor 49, variable resistor 50 and the charging capacitor 52. Assuming that the discharge transitor 34 is initially in the non-conductive state since a "low" signal is present at the "Q" output of flip-flop 28, the charging capacitor 52 will begin to charge toward the value of the supply voltage at a rate determined by the RC time constant of the circuit. The RC time constant, of course, is determined by the component value of resistors 49 and 50 and the capacitance of the charging capacitor 52. The RC time constant is initially established, as by choosing component values or altering the resistance of variable resistance 50, so as to produce electrical output pulses at a normal or basic frequency within the frequency range of the average human voice. The increasing and decreasing monitored signal present at node 51 is supplied via lead 53 to the second or monitored inputs of the comparators 25 and 26 for comparison with the first and second reference signals present at the first inputs of the comparators 25 and 26 respectively.

Detailed Description Text - DETX (19):

The variable resistor 63 of the transducer block 27 of FIG. 3 may be replaced with the circuit of FIG. 5 or an equivalent thereof if desired. The circuit of FIG. 5 shows the common node 62 but the resistance 63 of FIG. 3 has been replaced by the parallel combination of a first circuit branch 65 having a resistor 66 of a first value connected between the node 62 and ground. A second parallel branch 67 including a first manually-operable switch 68 in series therewith is connected between node 62 and ground so that when the user of the artificial larynx 10, or 18 of the present invention is an environment in which he does not desire to generate a high volume or loud signal, the switch 68 is opened so that the resistor 66 completes the circuit path to ground and produces a low volume output from the transducer means 28 of FIG. 3. Alternatively, when the user is in an environment requiring a higher volumn of sound, the switch 68 can be closed thereby completing a low impedance path between node 62 and ground so as to produce a high volume or loud output from the transducer means 28 of FIG. 3.

Detailed Description Text - DETX (20):

Similarly, as previously described, the variable resistor 50 of the RC circuit 25 of FIG. 3 may be replaced with the circuit of FIG. 4. The discharge node 37 may be coupled to the signal monitoring node 51 via a pair of parallel circuit branches 69, 70. The first circuit branch 69 includes a resistor of 73 of a first resistive value connected between a first switch terminal and the node 51 and the second branch 70 includes a second resistor 74 of a second resistive value connected between a second switch contact and the node 51. When the wiper arm 71 of the switch 72 is positioned to complete a current path between node 37 and the first branch 69 through the first resistor 73, a first RC time constant is established for the circuit 25 which will enable the circuit 24 to output a train of pulses at a frequency generally corresponding to the average fundamental frequency of a human female voice and when the wiper arm 71 of the switch 72 is positioned so as to connect node 37 with the second branch 70, the resistor 74 is placed into the circuit and establishes a second and different RC time constant for the circuit 25 to produce a train of output pulses at lead 32 whose basic frequency is in the average frequency range of the male human voice. Therefore, the mere positioning of the wiper arm 71 of the switch 72 between the two circuit arms 69 and 70 enable the artificial larynx of FIG. 3 to be preset for optimal tone quality for either a male or a female user, as desired. Similarly, both of the resistors 73 and 74 may be variable to allow the RC time constant to be more precisely tuned to the needs of the individual male or female, as desired.

Claims Text - CLTX (13):

2. The artificial larynx of claim 1 wherein said second RC circuit means includes a first circuit branch including a first resistive means connected between said power supply means and said output node, a first capacitor connected in parallel with said first circuit branch between said power supply means and said output node, a second circuit branch including a second resistive means connected between said output node and ground, a second capacitor connected in parallel with said second circuit branch between said output node and ground, the values of said first and second resistive means and said first and second capacitors establishing said predetermined rate at which the frequency control signal at said output node varies, and wherein said manually-operable switching means includes a first manually-operated switching means connected in said first circuit branch in series with said first resistive means, said second RC circuit means being responsive to the closure of said first manually-operable switching means for increasing the value of said frequency control signal at said predetermined established rate and a second manually-operable switching means connected in said second circuit branch in series with said second resistive means, said second RC circuit means being responsive to the closure of said second manually-operable switching means for decreasing the value of said frequency control signal at said predetermined established rate.

Claims Text - CLTX (14):

3. The artificial larynx of claim 2 wherein at least one of said first and second resistive means includes means for varying the value of the resistance thereof for changing the RC time constant of said pitch change circuit means so as to selectively alter said predetermined established rate.

Claims Text - CLTX (15):

4. The artificial larynx of claim 1 wherein said first RC circuit means for establishing the normal frequency at which said train of electrical output pulses is generated includes means for varying the rate at which said charging capacitor charges and discharges to vary said monitored signal so as to selectively increase and decrease the frequency of generation of said first and second triggering signals and therefore the normal frequency at which said train of electrical output pulses is generated.

Claims Text - CLTX (16):

5. The artificial larynx of claim 4 wherein said first RC circuit means includes resistive means connected in series between said power supply means and said charging capacitor, said resistive means including a first branch having a resistor of a first value therein and a second branch in parallel with said first branch and having a resistor of a lessor value therein, said resistive means further including switching means for selecting on of said branches to complete a series path between said power supply means and said charging capacitor, the selection of one of said branches establishing a basic frequency corresponding to the average fundamental frequency of a man's voice and the selection of the other of said branches establishing a basic frequency corresponding to the average fundamental frequency of a woman's voice.

Claims Text - CLTX (17):

6. The artificial larynx of claim 1 further characterized in that said driving means includes a switching means connected in a series current path with power supply means and said vibratory transducer means, said switching means being coupled to the output of said isolation means and being responsive to the train of electrical output pulses therefrom for driving said vibratory transducer means at a frequency predetermined by the frequency of generation of said train of electrical output pulses and variable impedance means in series with said switching means and said vibratory transducer means for controlling the volume of the sound generated by said vibratory transducer means.

Claims Text - CLTX (18):

7. The artificial larynx of claim 6 wherein said variable impedance means includes first and second parallel branches connected in series with said switching means, the resistance of one of said paths being greater than the resistance of the other of said paths and manually-operable switching means for selecting one or the other of said paths so as to produce a corresponding low volume or high volume output from said vibratory transducer means.

Claims Text - CLTX (19):

8. The artificial larynx of claim 1 wherein said vibratory transducer means includes inductive means and said larynx includes capacitive means coupled in parallel across said inductive means for producing desireable harmonics into the audio output form said vibratory transducer means.

Claims Text - CLTX (20):

9. In an artificial larynx having means for generating electrical pulses at a predetermined frequency in the average fundamental frequency range of the human voice, transducer means for vibrating at said predetermined frequency to generate sound waves which can be articulated in a person's speech cavities for speaking purposes and means responsive to said electrical pulses for driving said transducer means, the improvement comprising RC circuit means for generating a frequency control signal whose value varies at a predetermined rate established by the RC time constant of said RC circuit means;

Claims Text - CLTX (23):

10. The improved artificial larynx of claim 9 wherein said RC circuit means includes a first circuit branch having resistive means therein connected between a power supply and a frequency control signal output node, a second circuit branch having a capacitive means therein connected in parallel across said first circuit branch between said power supply and said output node, a third circuit branch having resistive means therein connected between said output node and ground, and a fourth circuit branch having a capacitive means therein connected in parallel across said third circuit branch between said output node and ground, the values of said first and second resistive means and said first and second capacitive means determining the RC time constant of said RC circuit means and therefore establishing the predetermined rate at which said frequency control signal produced at said output node increases and decreases in value, said switching means including a first manually-operable switch connected in series in said first circuit branch such that the

closure thereof initiates the charging of the capacitive means of said fourth circuit branch thereby increasing the value of said frequency control signal at said output node and a second manually-operable switch in series with said third circuit branch for completing a current path to discharge the capacitive means of said second circuit branch to decrease the value of said fequency control signal at said output node thereby enabling said person to determine the direction of pitch change by selecting which of said first and second switches are to be closed.

Claims Text - CLTX (24):

11. The improved artificial larynx of claim 9 wherein said RC circuit means includes a first series path coupled between a power supply means and ground, said first circuit path including a resistive means and a charging capacitor, one plate of said charging capacitor being coupled to ground and an output node being provided that the junction of said resistive means and said charging capacitor for outputting said frequency control signal, the values of said resistive means and said charging capacitor establishing the RC time constant of said series circuit thereby establishing a predetermined rate at which the value of said frequency control signal varies; and wherein said manually-operable switching means includes a manually-operable switch coupled into said first series circuit, the closure of said switch completing a circuit path between said power supply means and ground for charging said charging capacitor and increasing the value of said frequency control signal at said output node at the predetermined rate determined by the established RC time constant of said series circuit.

Claims Text - CLTX (25):

12. The improved artificial larynx of claim 9 wherein said RC circuit means includes a series circuit path coupled between said a power supply means and ground, said series circuit path including a charging capacitor having one plate coupled to said power supply and its other plate coupled to a frequency control signal output node, said node being coupled through a resistive means to ground, the values of said resistive means and said charing capacitor establishing the RC time constant of said series circuit and therefore the predetermined rate at which the value of said frequency control signal varies; and wherein said manually-operable switching means includes a manually-operable switch connected in said series path such that the closure of said switch completes an electrical circuit between said charging capacitor and ground for discharging said charging capacitor through said resistive means to decrease the value of said frequency control signal at the predetermined rate established by the RC time constant of said series circuit.

Claims Text - CLTX (26):

13. The improved artificial larynx of claim 10 wherein at least one of the resistive means of said first branch and the resistive means of said third branch may be selectively varied to change the RC time constant of said RC circuit means thereby varying said predetermined established rate at which the value of said frequency control signal increases and decreases.

Claims Text - CLTX (27):

14. The improved artificial larynx of claim 9 further characterized in that said transducer means includes a coil and the improvement includes capacitive means connected across said coil for inroducing desireable harmonics into the sound generated by said transducer means to eliminate mechanically sounding monitones and produce a more human-sounding voice.

Claims Text - CLTX (28):

15. The improved artificial larynx of claim 9 wherein said electrical pulse-generating means includes a second RC circuit means for normally establishing the frequency of generation of said electrical pulses in the average fundamental frequency range of a human voice and further includes means for varying the RC time constant thereof to selectively increase or decrease the normal fundamental frequency of generation of said pulses to suit the needs of the user.

Claims Text - CLTX (29):

16. The improved artificial larynx of claim 15 wherein said means for selectively increasing and decreasing the normal frequency of generation of said electrical pulses includes a parallel circuit branch having first impedance means of a first value in a first branch thereof for establishing an RC time constant to produce a lower frequency of generation of signals generally associated with a man's speech and a second parallel branch having second impedance means of a different value for producing a frequency of generation of said electrical pulses at a rate normally associated with a woman's voice, and wherein said second RC circuit means includes switching means for selecting one of said first and second branches.

Claims Text - CLTX (30):

17. The improved artificial larynx of claim 9 wherein said driving means includes means for selectively increasing and decreasing the volume of sound outputted from said vibratory transducer means.

Claims Text - CLTX (32):

19. The artificial larynx of claim 18 wherein said circuit means for establishing the rate at which the value of said frequency control signal automatically increases and decreases includes a first series path coupled between said power supply means and ground, said first series path including a resistive means and a charging capacitor, the juncture of said resisted means with said charging capacitor serving as an output node for said frequency control signal, the opposite plate of said capacitor means being coupled to ground, said circuit means further including a second series path coupled between said power supply means and ground, said second series path including a second charging capacitor and a second resistive means, the juncture of said second charging capacitor and said second resistive means corresponding to said output node and the opposite plate of said second charging capacitor being coupled to said power supply means; and wherein said manually-operable switching means includes a first manually operable switch interposed in said first series circuit such that the closure of said switch completes a current path between said source of potential and ground for charging said first charging capacitor so that the frequency control signal generated at said output node increases at a rate determined by the RC time constant of said first series circuit, and a second manual-operable switch interposed in said second series path for completing a discharge circuit between said second charging capacitor and ground through said second resistive means for discharging said capacitor and decreasing the value of said frequency control signal at said output node at a rate determined by the RC time constant of said second series path.

Claims Text - CLTX (33):

20. The artificial larynx of claim 18 wherein said pulse generating means includes:

Claims Text - CLTX (34):

a first comparator having first and second inputs and an output, said first comparator being responsive to the equality of the signals present at said first and second inputs for generating a first triggering signal at the output thereof;

Claims Text - CLTX (35):

a second comparator means having first and second inputs and an output, said second comparator means being responsive to the equality of the signals present at said first and second inputs for generating a second triggering signal at the output thereof;